

Michigan Department of Environmental Quality  
Environmental Science & Services  
and  
Water Bureau

**Study Guide  
of  
Typical Exam Content  
for  
Waterworks Operator  
Certification Examinations**

# **FILTRATION**

## **F CLASSIFICATIONS**

- F-4 Entry Level of Certification**
- F-3 Intermediate Level of Certification**
- F-2 Advanced Level of Certification**
- F-1 Highest Level of Certification**

**Written Examinations:** The written examinations for all classifications are developed from need-to-know type exam questions. The design of the questions has been selected so that they are clear, not misleading or tricky.

**Style of Questions:** All exam questions are multiple choice. The style of questions and number of questions may change without notice.

**Exam Content:** The subjects typically covered on the various certification examinations are grouped by exam on the following pages. These subjects may change without notice.

## **F-4 & F-3 Study Guide**

### **Alkalinity**

Definitions, types, procedures, reagents used, etc.

### **Chemistry**

Treatment chemistry (compounds, elements, atomic weights, etc), chemical symbols and properties of important water treatment chemicals.

### **Coagulation & Flocculation**

Bench testing (influential factors, procedure, apparatus and chemicals used, etc.). Mechanics of coagulation & flocculation and its importance.

### **Contingencies and Emergencies**

Contingency Plan (Requirements, key topics, examples).

### **Corrosion**

Causes/Effects of corrosion on interiors/exterior, testing.

### **Cross Connections**

Definition; prevention and/or correction (devices and when each is used). Which agency is responsible for inspections.

### **Customer Relations**

Principles to maintain a good public image, contact with the public and handling customer complaints.

### **DBP's**

Definitions, MCL, reactions, causes, turbidity effects, etc.

### **Disinfection**

Chemicals used, all aspects of disinfection with chlorine (CT, PPM Calculations, etc.), methods for – DPD residual testing, storage, testing, handling, safety, etc), chemical feeding.

### **Filtration**

Definitions, backwashing (procedures, cause/effect of mud balls, etc), turbidity measurements, hydraulic calculations (loading, operation, design, etc.)

### **Fluoridation**

Chemicals used, dosage calculations, reasons for addition, safety and handling, regulations, chemical feeding.

### **Hydraulics**

Definitions, volume, density, area, circumference, pressure/hydraulic head calculations, abbreviations/conversions.

### **Instrumentation**

What processes should be instrumented and why? Measuring & control of water equipment such as float levels and weirs, flow measurements, pressure controls, electrical controls.

### **Laboratory**

Procedures, techniques, equipment, medias, preservatives, calculations, thorough understanding of results, routine testing, etc.

### **Management**

Handling given management situations (town meetings, employee relations, motivation), budgets.

### **Membrane Technology**

Types of membranes (Reverse Osmosis, Microfiltration, etc.), selectivity of membranes, cleaning of membranes.

### **Microbiology**

Definitions, testing procedures, standard methods for analysis, medias used etc. Classification of waterborne diseases (viruses, bacteria, protozoa, etc.)

### **O & M**

Procedures for general & preventative maintenance of equipment, trouble shooting.

### **Other Disinfectants**

Advantages and disadvantages, types, properties.

### **Pretreatment**

Definitions, techniques, clarification, chemical feeding.

### **Pumps & Motors**

Understanding of pumps and motors, their operation, types, trouble shooting, calculations, etc.

### **Recordkeeping**

Water quality & samples results (bacteriological and chemical), MDEQ operation reports, data management.

### **Safety**

Personal & site safety associated with laboratory, chemicals, equipment, plant operations, etc.

### **Sampling**

Procedures (pre-sampling, sampling bacteriological/chemical, Pb/Cu), results (understand and interpret), routine sampling (regulation, benefits, etc), sample preservation techniques and handling procedures.

### **SDWA**

Michigan Safe Drinking Water Act, (rules & regulations), National Primary & Secondary Drinking Water Standards, operator certification, MCL's, notification, regulated compounds, etc., public health.

### **Sludge**

Sources, disposal methods, etc.

### **Softening**

Lime-Soda process, dosage calculations, etc.

### **Source**

Definitions, well appurtenances, hydrologic cycle, types (sampling requirements), properties of water, lake cycles.

### **Storage**

Design calculations, maintenance, contact time, piping, pumpage rates.

### **Taste & Odor**

Causes and solutions to taste and odor complaints, Standard Methods tests.

## **F-2 Study Guide**

### **Alkalinity & Hardness**

Definition, types, procedures, calculations, reagents used, end points, etc.

### **Chemistry**

Treatment chemistry (compounds, elements, atomic weights, uses in water treatment, etc.) chemical formulas, analytical methods, molarity/normality.

### **Chlorination**

All aspects of disinfection with chlorine (CT, ppm calculations, feed rates, tanks, properties, bi-products, etc.), methods (DPD, storage, testing, handling, safety, chemical formulas, etc.)

### **Coagulation & Flocculation**

Bench testing (influential factors, procedure, apparatus used, etc.), seasonal problems, calculations (ex. alum), mechanics of coagulation & flocculation and its importance.

### **Contingencies & Emergencies & Security**

Contingency plan (requirements, key topics, examples, etc.), notification procedures, security devices & protocol

### **Corrosion**

Causes/effects of corrosion on interiors/exterior, how to control, Langelier index.

### **Cross Connections**

Definition, prevention and/or correction (devices and when each is used), frequency of testing, what agency is responsible for inspections?

### **Customer Relations**

Describe situations where you may come in contact with the public, how to handle these situations and, maintain a good public image.

### **Filtration**

Backwashing (procedures, cause/effect of mud balls, temp, etc.), filter operation problems (causes/solutions), turbidity measurements, hydraulic calculations (loading, operation, design, backwashing, etc.), gradation (uniformity coef, effective size, etc.)

### **Fluoridation**

Dosage calculations, reasons for addition, types and chemical formulas (purity)

### **Hydraulics**

Volume, density, area, circumference, and pressure/hydraulic head calculations, abbreviations/conversions, design calculations for all treatment processes, meters (types, advantages/disadvantages, design or layout, etc.), pumping rates/efficiency.

### **Instrumentation**

Types of actuators, reliability, accuracy, problems, compatibility, etc. What processes should be instrumented and why?

### **Laboratory**

Procedures, techniques, equipment, medias, preservatives, etc., thorough understanding of results, routine testing, etc.

**Management**

How to handle given management scenarios (town meetings, employee discipline, hostile customers, etc.), manager functions (supervising, staffing, etc.)

**Membrane Technology**

Types of membranes (reverse osmosis, microfiltration, etc.), selectivity of membranes, cleaning of membranes.

**Microbiology**

Testing procedures (incubation times, etc.), standard methods for analysis, medias used & media preparation, classification of waterborne diseases (viruses, bacteria, protozoa, etc.), plankton (properties, etc.)

**O & M**

Operational procedures and common Installations.

**Other Disinfectants**

Advantages/disadvantages, types, their properties, etc.

**Pretreatment**

Definition, techniques, why it is used, etc.

**Pumps & Motors**

Understanding of pumps, motors, their operation, types, trouble shooting, horsepower calculations, etc.

**Recordkeeping**

Water quality & sample results (bacteriological/chemical), MDEQ operation reports.

**Safety**

Personal & site safety associated with laboratory, chemicals, equipment, etc.

**SDWA**

Michigan Safe Drinking Water Act, (rules & regulations), National Primary & Secondary Drinking Water Standards, operator certification, MCL's, notification, regulated compounds, etc., public health.

**Sludge**

Calculation of amount, sources, disposal methods, etc.

**Softening**

Lime-soda process, dosage calculations, etc.

**Source**

Types (sampling requirements), properties of water, lake cycles, etc.

**Storage**

Design calculation, pumpage rates, maintenance, etc.

**Taste & Odor**

Standard Methods test, causes, solutions, etc.

**THMs**

Definition, MCLs, reactions, causes, turbidity effects, etc.

# F-1 Study Guide

## **Alkalinity & Hardness**

Definition, types, procedures, calculations, reagents used, end points, etc.

## **Chemistry**

Treatment chemistry (compounds, elements, atomic weights, uses in water treatment, etc) chemical formulas, analytical methods, molarity/normality

## **Chlorination**

All aspects of disinfection with chlorine (CT, ppm calculations, feed rates, tanks, properties, bi-products, etc.), methods (DPD, storage, testing, handling, safety, chemical formulas, etc.)

## **Coagulation & Flocculation**

Bench testing (influential factors, procedure, apparatus used, etc.), seasonal problems, calculations (ex. alum), mechanics of coagulation & flocculation and its importance.

## **Contingencies & Emergencies & Security**

Contingency plan (requirements, key topics, examples, etc.), notification procedures, security devices & protocol.

## **Corrosion**

Causes/effects of corrosion on interiors/exterior, how to control, Langelier index.

## **Cross Connections**

Definition, prevention and/or correction (devices and when each is used), frequency of testing, which agency is responsible for inspections?

## **Customer Relations**

Describe situations where you may come in contact with the public, how to handle these situations and, maintain a good public image.

## **Filtration**

Backwashing (procedures, cause/effect of mud balls, temp, etc.), filter operation problems (causes/solutions), turbidity measurements, hydraulic calculations (loading, operation, design, backwashing, etc.), gradation (uniformity coef., effective size, etc.)

## **Fluoridation**

Dosage calculations, reasons for addition, types and chemical formulas (purity).

## **Hydraulics**

Volume, density, area, circumference, and pressure/hydraulic head calculations, abbreviations and conversions, design calculations for all treatment processes, meters (types, advantages and disadvantages, design or layout, etc.), pumping rates/efficiency.

## **Instrumentation**

Types of actuators, reliability, accuracy, problems, compatibility, etc., what processes should be instrumented and why?

## **Laboratory**

Procedures, techniques, equipment, medias, preservatives, etc., thorough understanding of results, routine testing, etc.

**Management**

How to handle given management scenarios (town meetings, employee discipline, hostile customers, etc.), manager functions (supervising, staffing, etc.)

**Membrane Technology**

Types of membranes (reverse osmosis, microfiltration, etc.), selectivity of membranes, cleaning of membranes.

**Microbiology**

Testing procedures (incubation times, etc.), standard methods for analysis, medias used & media preparation, classification of waterborne diseases (viruses, bacteria, protozoa, etc.), plankton (properties, etc.)

**O & M**

Operational procedures and common installations.

**Other Disinfectants**

Advantages/disadvantages, types, their properties, etc.

**Pretreatment**

Definition, techniques, why pretreatment is used, etc.

**Pumps & Motors**

Understanding of pumps, motors, their operation, types, trouble shooting, horsepower calculations, etc.

**Recordkeeping**

Water quality & sample results (bacteriological/chemical), MDEQ operation reports.

**Safety**

Personal & site safety associated with laboratory, chemicals, equipment, etc.

**SDWA**

Michigan Safe Drinking Water Act, (rules & regulations), National Primary & Secondary Drinking Water Standards, operator certification, MCL's, notification, regulated compounds, etc., public health.

**Sludge**

Calculation of amount, sources, disposal methods, etc.

**Softening**

Lime-soda process, dosage calculations, etc.

**Source**

Types (sampling requirements), properties of water, lake cycles, etc.

**Storage**

Design calculation, pumpage rates, maintenance, etc.

**Taste & Odor**

Standard methods test, causes, solutions, etc.

**THMs**

Definition, MCLs, reactions, causes, turbidity effects, etc.

The following is a list of selected references for the **F-1 and F-2 examinations only**.

- Michigan Safe Drinking Water Act, 1976 P.A. 399 as amended
- Water Treatment Plant Operation, Volume I, California State University, Sacramento, CA, 4<sup>th</sup> or 5<sup>th</sup> Edition
- Water Treatment Plant Operation, Volume II, California State University, Sacramento, CA, 3<sup>rd</sup> Edition
- Water Distribution System Operation & Maintenance, California State University, Sacramento, CA, 4<sup>th</sup> or 5<sup>th</sup> edition
- Small Water System Operation & Maintenance, California State University, Sacramento, CA, 4<sup>th</sup> Edition
- MDEQ Cross Connection Rules Manual, Third Edition
- Standard Methods for the Examination of Water and Wastewater, 20<sup>th</sup> edition
- Hydraulics for Operators, Revised Edition, Wm. Elgar Brown, 1985, Michigan Section AWWA
- Recommended Standards for Water Works Design, 2003 Edition
- Water Quality & Treatment, 5<sup>th</sup> Edition, AWWA
- Handbook of Public Water Systems, 2<sup>nd</sup> Edition, HDR Engineering, Inc.

The following is a list of selected references for the **F-3 and F-4 examinations only**.

- Michigan Safe Drinking Water Act, 1976 P.A. 399 as amended
- Water Treatment Plant Operation, Volume I, California State University, Sacramento, CA, 4<sup>th</sup> or 5<sup>th</sup> Edition
- Water Treatment Plant Operation, Volume II, California State University, Sacramento, CA, 3<sup>rd</sup> Edition
- Water Distribution System Operation & Maintenance, California State University, Sacramento, CA, 4<sup>th</sup> or 5<sup>th</sup> edition
- Small Water System Operation & Maintenance, California State University, Sacramento, CA, 4<sup>th</sup> Edition
- Water Quality & Treatment, 5<sup>th</sup> Edition, AWWA
- Handbook of Public Water Systems, 2<sup>nd</sup> Edition, HDR Engineering, Inc.

The Michigan Safe Drinking Water Act can be found on the Internet at [www.michigan.gov/deq](http://www.michigan.gov/deq). After you get to this site, click on **Water** and then **Drinking Water** and then **Community Water**. If you scroll down with your cursor, you can locate the laws that will include the Michigan Safe Drinking Water Act.